

8 ECOSYSTEM RESTORATION FEATURES AND RESEARCH ACTIONS [ESA SECTION 7(a)(1)]

8.1 Introduction

This section of the BA addresses additional ecosystem restoration and research actions added to the proposed action previously described. Pursuant to Section 7(a)(1) of the ESA, the federal agency, in this instance the Corps, “shall utilize their authorities in furtherance of the purposes of this chapter by carrying out programs for the conservation of endangered species and threatened species” [16 U.S.C. § 1536(a)(1)]. These actions are not measures intended to directly address take of listed species. However, they are measures that the Corps, with the assistance of the Services, has determined to be important to aid in the recovery of listed salmonids and, in some cases, address habitats that were the subject of much discussion and analysis throughout the reconsultation process.

The Corps proposes to implement ecosystem restoration features and research actions under Section 7(a)(1) of the ESA, as described in the following sections. The ecosystem restoration and research components proposed below will be cost-shared by the Sponsor Ports and are hereby considered part of the Project.

8.2 Ecosystem Restoration Features

Restoration features will be done by the Corps under this BA to create or improve salmonid habitat, specifically tidal marsh, swamp, and shallow water and flats habitat. In addition to the three original restoration features proposed in the 1999 FEIS, the Corps proposes to implement six more restoration features: Lois Island Embayment Habitat Restoration, Purple Loosestrife Control Program, Miller/Pillar Habitat Restoration, Tenasillahe Island Tidegate/Inlet Improvements (interim) and Dike Breach (long term), Cottonwood/Howard Island Columbia White-Tailed Deer Introduction, and Bachelor Slough Restoration. Interim actions at Tenasillahe Island are contingent on hydraulic engineering analyses demonstrating the feasibility of the proposed action and that no adverse impacts would be incurred by Columbia white-tailed deer. Implementation of the long-term action at Tenasillahe Island is contingent on delisting of Columbia white-tailed deer and determination that such actions are compatible with the purposes and goals of the refuge. The Bachelor Slough Restoration is contingent on securing easements from the Washington Department of Natural Resources (WDNR) and favorable sediment testing results. The Cottonwood/Howard Restoration is also contingent on acquisition of the site by the Sponsor Ports. Each of these actions is described below in Sections 8.2.1 through 8.2.6, followed by an analysis of their effects in Section 8.4.

8.2.1 Lois Island Embayment Habitat Restoration (RM 19)

The embayment between Lois and Mott Islands was dredged out during the World War II era to provide moorage for decommissioned naval ships. Prior to that time, the area was shallow subtidal and intertidal habitat with interspersed drainage channels. Lois and Mott Islands and South Tongue Point were formed from material dredged from this location. This ecosystem restoration feature will restore 389 acres of tidal marsh habitat.

Prior to construction of the embayment, the area contained intertidal mudflats and shallow subtidal flats plus a centralized channel 12 to 18 feet in depth running from northwest to southeast across much of the area. The average depth of the area was 5 to 6 feet with substantial area above zero feet in elevation (CREDDP, 1983: 1935 bathymetric map). Intertidal habitat would have ranged from -2 to 10 feet at this area of the Columbia River.

Post-construction of the moorage area, an embayment with rough dimensions of 3,750 feet by 4,375 feet was formed, with depths ranging from 12 to 30 feet and averaging 25 to 26 feet (CREDDP, 1983: 1958 bathymetric map). The eastern portion of the embayment is wider and juts slightly into Lois Island.

By 1982 (CREDDP, 1984: 1982 bathymetric map), depths in the embayment were approximately 21 feet on average, ranging from 18 to 24 feet. Lois and Mott Islands have developed narrow, fringing intertidal marsh habitat post-dredging on their interior shorelines bordering the embayment.

Given that the embayment filled in approximately 4 feet from 1958 to 1982, it is assumed that additional sedimentation has occurred between 1982 and 2001. Assuming that 3 feet of material has accumulated in that period, the embayment may currently average approximately 18 feet in depth or roughly 13 feet deeper than historical depths.

The restoration feature includes reconstruction of the area to historical elevations using dredged material from the Columbia River navigation channel. The shallow subtidal and intertidal habitats formerly present and proposed for restoration were more productive than the current, moderately deep, subtidal habitat. Gross benthic productivity for the fringing intertidal mudflat habitat at the embayment was 31 to 46 grams of carbon per square meter per year (CREDDP, 1984), which is comparable to other intertidal mudflat habitat in Cathlamet Bay. Tidal marsh plant standing crop at South Tongue Point was slightly above average for Cathlamet Bay (CREDDP, 1984).

Cates (1983) conducted fish sampling operations in the Tongue Point area in 1979 and again in 1981. Five of his seven sampling locations were within the Lois Island Embayment. These sampling locations were just beyond the intertidal marsh/mudflat interface on the periphery of the embayment. Thus, they are roughly comparable to the habitat conditions sought in the restoration action.

Cates (1983) captured 14 species, including four anadromous salmonids (chinook salmon, coho salmon, chum salmon, and cutthroat trout) in 1981, the year for which he provided the most detailed results. Chinook salmon were the most abundant salmonid captured in 1981 – 3,411 individuals of 3,619 salmonids captured (94 percent). Chinook juveniles were present in the area from March to late August, with peak abundance in May. Based on their size and period of occurrence, most of the chinook captured were considered to be subyearling fall chinook.

Chum salmon (147), coho salmon (61), and cutthroat trout (2) were of lesser abundance based on their beach seine results. Cates (1983) indicated that chum salmon captured were thought to be of wild origin as their occurrence preceded hatchery releases. He also captured juvenile chinook and coho salmon with coded wire tags at Tongue Point sampling locations. These included chinook salmon from the Klaskanine River, which empties into Youngs Bay immediately downstream of Astoria, and one coho salmon from the Grays River, Washington. These captures were an indication of upstream movement of chinook to the Tongue Point area for estuarine rearing and cross-river movement for coho.

Tongue Point and the embayment are used for a terminal salmon fishery, and commercial gill netting also occurs for sturgeon in the embayment. Sport fishing in the embayment is limited to a few boats fishing for sturgeon. Most sport fishing boats that launch from the nearby John Day boat ramp fish for sturgeon on the channelward side of Mott Island and off Tongue Point proper.

Emmett, et al. (1986), investigated benthic invertebrates in Cathlamet Bay, including the embayment between Lois and Mott Islands. They identified 28 benthic invertebrate species or groups (order, family, genus) as occurring within the embayment. Eight (*Cumacea*, *Corophium salmonis*, *Harpacticoida*, *Helidae* [larvae], *Insecta*, *Diptera* [adult], *Scottolana canadensis*, and *Chironomid*) are preferred prey resources of juvenile salmonids. Their sampling occurred at depths of 16 to 20 feet. These species are

also anticipated to be present in the intertidal mudflat and shallow subtidal habitat that would be present after restoration.

The area of the proposed restoration feature is approximately 389 acres. It runs from the southwest corner of the embayment off the John Day River mouth on a northwest-bearing line to the corner of the embayment south and east of Mott Island (CREDDP, 1983; see 1982 bathymetric map). The inner channel from John Day Point along South Tongue Point to Tongue Point would not be affected by restoration actions. The edge of the restoration area would be approximately 1,250 feet off South Tongue Point.

Restoration of the Lois Island Embayment would require approximately 8 mcy of material. It is estimated that 7 mcy from initial construction of the deepened channel could be placed at Lois-Mott Island embayment. The initial construction material would originate from the navigation channel between RM 3 and 30. The approximately 1 mcy of material needed to complete the restoration action would come from the navigation channel between RM 3 and 20. An estimated 2 to 3 years of O&M dredging would be required to complete the restoration action. Material dredged from the navigation channel would be transported via hopper dredge and initially placed in the upstream Tongue Point turning basin. No deep draft vessels currently call at Tongue Point because industrial facilities requiring their service have not been developed at this location. Consequently, placement of dredged material in the turning basin would not compromise vessel traffic. After placement of dredged material in the turning basin, a pipeline dredge would be used to transfer the material into the embayment to the target elevations. These target elevations would be predicated on the historical bathymetry of the area. The following actions will be taken as part of the Lois Island Embayment Habitat Restoration effort:

- Fund and implement construction effort
- Monitor post-construction benthic productivity and fish species composition and density on the restoration site and an adjacent control site

8.2.2 Purple Loosestrife Control Program

Purple loosestrife is an introduced exotic plant that is spreading throughout emergent tidal marshes in the Columbia River estuary. Native vegetation such as Lyngby's sedge, tufted hair grass, wapato, and softstem bulrush are being displaced. Currently more than 10,000 acres of estuarine tidal marsh are infested, although the degree of infestation varies widely among locations. Large, dense stands, totaling perhaps 300 acres, are found at Karlson Island (RM 26), Miller Sands (RM 22.5), and North Wallace Island (RM 50). Loosestrife densities range from light (a few scattered plants) to moderate in other areas of the estuary. Given its history in other regions of North America, it is likely that loosestrife, if left unchecked, will dominate the emergent marsh habitat of the estuary to the exclusion of native vegetation. This would greatly reduce biological diversity and negatively affect most estuarine wildlife, including salmonids and other native fish, waterfowl, waterbirds, shorebirds, neotropical migrant birds, bald eagles, native mammals, and amphibians.

The goal of this program will be to eradicate the large stands and bring about a major reduction in loosestrife densities in emergent marsh in the estuary. An Integrated Pest Management approach will be used. The focus will be on biocontrol of dense stands, with thorough mapping and monitoring to determine the effectiveness of biocontrol in this tidal situation. Herbicides and mechanical methods will be used where plant densities are low to moderate. Rodeo, an EPA-registered herbicide approved for over-water application, would be used in conjunction with biocontrol and mechanical treatments to treat purple loosestrife infestations.

The following actions will be taken as part of the Purple Loosestrife Control ecosystem restoration feature:

- Project funding for field implementation of survey and control actions, including equipment and personnel expenses, for a 5-year effort
- All necessary coordination with local, state, and federal government agencies to accomplish the effort
- Provision of annual and final reports describing the nature and extent of the effort and results

8.2.3 Miller/Pillar Habitat Restoration (RM 26)

This ecosystem restoration feature is located between Miller Sands and Pillar Rock Islands in the Columbia River estuary (RM 25 to 26). More than 160 acres will be created. Natural processes are currently eroding material south of the navigation channel and redepositing the material in the navigation channel. This erosive action has been occurring since 1958 at an average annual rate of approximately 70,000 cubic yards. The erosion is affecting productive, shallow water and flats habitat (zero to 5.9 feet CRD) and converting the area to less productive, deep subtidal habitat (a minimum depth of 24.9 feet CRD) (Hinton, et al., 1995). Hinton, et al. (1995), conducted field investigations of benthic invertebrates, fish, and sediments at this location in 1992 and 1993. Their investigation compared resource values of the erosive area to adjacent shallow water and flats habitat.

Hinton, et al. (1995), determined that benthic invertebrate densities were significantly higher in the shallow water and flats habitat than in the proposed habitat restoration (erosive) area. The number of benthic invertebrate species was comparable between the erosive and natural site although species diversity was significantly higher in the shallow water and flats habitat. Overall, *Corophium salmonis* was the most abundant invertebrate in both study areas. *Corophium salmonis* is significantly denser in the shallow water and flats habitat compared to the deeper, erosive area. This species is an important forage resource for juvenile salmonids in the Columbia River estuary.

Eighteen species (17 fish, 1 shrimp) were collected in the two study sites (Hinton, et al., 1995). These included anadromous, marine, and freshwater fish species. Anadromous species collected included lamprey, white sturgeon, American shad, coho salmon, sockeye salmon, chinook salmon, and steelhead. Overall, the most abundant fish species in the proposed habitat restoration area were peamouth, prickly sculpin, starry flounder, and juvenile salmonids (zero to 692 individuals; all species combined). American shad, subyearling chinook, peamouth, threespine stickleback, and starry flounder were the most abundant fish in the shallow shallow water and flats habitat. Juvenile salmonids ranged from zero to 1,719 individuals collected per sampling period in the shallow water and flats habitat. Hinton, et al. (1995), reported that densities of subyearling chinook salmon in 1993 averaged 417 fish per acre in the proposed restoration area and 2,628 fish per acre in the shallow water and flats habitat.

Hinton, et al. (1995) reported that median sediment grain size was significantly larger in the restoration area (0.28 mm) than in the adjacent shallow water and flats habitat (0.22 mm). Mean percent silt/clay was higher in the shallow water and flats habitat than in the restoration area. Habitats within the proposed habitat restoration area appeared to be separated into at least two types and corresponded to the north and south sampling transects established by Hinton, et al. (1995). The south transect had significantly smaller sediment grain size and a significantly higher density of *Corophium*. Water depth was also less along the south transect, and NMFS estimated that bottom water velocities were also less along their southern transect. The southern transect is farthest from the navigation channel. The smaller sediment grain size, shallower depth, and lower velocity associated with the southern transect compared to the northern transect result in a more favorable substrate for *Corophium salmonis*.

Hinton, et al. (1995), stated that research results suggest that the habitat value of the proposed habitat restoration area could be enhanced by proper placement and stabilization of dredged material from the Columbia River to create habitat comparable to that in the adjacent shallow subtidal area. Placement of dredged material and its stabilization would create more favorable conditions for *Corophium salmonis* (e.g., reduced water velocities, decreased median grain size, increased percent silt/clay, and increased percent volatile solids). A subsequent increase in standing crop of *Corophium salmonis* should provide more food and rearing habitat for fishes, including juvenile anadromous fish (Hinton, et al., 1995).

Restoration of the erosive area to a productive, shallow water and flats habitat can be accomplished by placement of dredged material at the location to mimic historical depths. Assuming that the restoration area had a historical average depth of 2.95 feet CRD and currently has a minimum depth of 24.9 feet CRD, an increase of 22 feet of depth or 5,750,000 cubic yards of material would be required to retain historical subtidal depths. Dredged material placed at this location would be comparable to *in situ* materials. Dredged material retention will require the construction of pile dikes to reduce water velocities and maintain the desired substrate elevations. Five pile dikes, which make up the Miller-Pillar pile dike field, would be constructed during the initial construction phase of the channel deepening.

The dredged material would be obtained from the deepened navigation channel during subsequent maintenance dredging operations. This restoration feature would be phased during construction, with fill placed to the target depth, beginning at the upstream border and moving downstream. This would create shallow water habitat so that benefits to salmonids would begin accruing as soon as dredging materials become available. The time frame to accomplish this restoration depends on the volume of maintenance dredging material that accumulates in the navigation channel. Pipeline dredges would supply the material from adjacent bars, as the area is too shallow for placement via hopper dredge. Barging of material to the location for placement is physically feasible, although unlikely from a cost standpoint. River and tidal currents, in conjunction with wave action, are expected to re-establish bathymetry at the location comparable to historical conditions once the dredged material has been placed.

Concerns were previously raised that construction of pile dikes would create perches that aid bird predation of juvenile salmonids, particularly by double-crested cormorants. To address this concern, the Corps has placed bird excluders atop numerous Columbia River estuary pile dikes. These excluders, which are placed atop pilings and spreaders on pile dike structures, were intended to preclude perching by double-crested cormorants. Oregon State University researchers have monitored these devices, and their efficacy in precluding cormorants, in 2000 and 2001. Their observations indicate that the bird excluders effectively preclude cormorants from perching on pile dikes and also significantly reduce the number of cormorants foraging in the water column in the vicinity of the pile dikes.

The following actions will be taken as part of the Miller-Pillar ecosystem restoration feature:

- Fund and implement construction effort
- Monitor post-construction benthic productivity and fish species composition and density on the restoration site and an adjacent control site
- Operate and maintain pile dikes and associated bird excluders for project life

8.2.4 Tenasillahe Island Interim and Long-Term Restoration

Two actions are anticipated for this location. The interim action would be directed at improving connectivity and water exchange between sloughs/backwater channels interior to the levees and the Columbia River. This would be accomplished through interim and long-term improvements to tidegates

and provision of controlled inlets to improve water movement and accessibility for juvenile salmonids. Implementation of the interim action is contingent on hydraulic engineering analyses to ensure that any improvement will not compromise habitat integrity for Columbia white-tailed deer that inhabit Tenasillahe Island. Under the long-term action, the levees would be breached to restore full tidal circulation to approximately 1,778 acres of former intertidal marsh/mudflat and forested swamp habitat. This long-term action is contingent on delisting of the Columbia white-tailed deer and determination that such actions are compatible with the purposes and goals of the refuge, to include restoration of intertidal marsh/mudflat and forested swamp habitat for ESA Critical Habitat for salmonids.

Tenasillahe Island is a large natural island in the Columbia River between RM 35 and 38 and immediately downstream of Puget Island. Actions to place levees around the bulk of the island began around 1910. Currently, approximately 1,778 acres of Tenasillahe Island are protected from inundation by the Columbia River. A main flood protection levee encompasses the majority of the island except for a parcel at the upstream tip. Tidegates, located at the downstream tip of the island, drain interior waters to Clifton Channel.

Prior to construction of these levees, the island was primarily intertidal in nature, with three major and numerous minor natural drainage channels bisecting the island. Intertidal marsh and mudflats, subtidal channels, and forested swamp historically would have been the principal fish and wildlife habitat on the island. Juvenile salmonids use of the historical habitat at Tenasillahe Island was probably extensive given the large extent of subtidal channels. The intertidal marsh and mudflat habitat would have supported substantial populations of various waterfowl and shorebirds, plus many other species, and would have exported considerable detritus to the Columbia River estuary.

Tenasillahe Island is currently a component of the Julia Butler Hansen Columbia White-Tailed Deer National Wildlife Refuge. The island is managed to provide habitat for the deer, a federally listed endangered species. The levees, tidegates, and other associated infrastructure are maintained to aid in the management of the Columbia white-tailed deer. Interior lands are primarily maintained as wet pastures through mowing and grazing activities to provide adequate quantity and quality of forage for the deer.

The Service's recovery population goal for Columbia white-tailed deer is a minimum of 400 deer occurring in three secure and viable subpopulations (e.g., 50 deer with 32 breeding adults). There are currently four recognized subpopulations of Columbia white-tailed deer located at Tenasillahe Island, Westport, the mainland portion of the Julia Butler Hansen Columbia White-Tailed Deer National Wildlife Refuge, and Puget Island. However, only the mainland Julia Butler Hansen Columbia White-Tailed Deer National Wildlife Refuge and Tenasillahe Island subpopulations are considered secure subpopulations as both are refuge lands owned by the USFWS. Consequently, one additional secure and viable population is required to meet the recovery plan goal.

8.2.4.1 Step 1 – Interim Restoration Features

The interim ecosystem restoration features include retrofitting tidegates and introduction of Columbia River flows to the heads of two sloughs in order to reintroduce juvenile salmonids to the interior sloughs and assure their ability to exit the interior sloughs. Tidegates would be retrofitted with aluminum doors or other suitable structures to allow fish access and egress over longer periods of time and tidal flows. Controlled inlet structures could be placed at the heads of sloughs to allow for ingress of Columbia River waters, thus drawing juvenile salmonids into the slough system. Approximately 92 acres of backwater channel habitat would be affected by the proposed interim ecosystem restoration feature to improve tidegates for fish access/egress and to install water control structures to improve flow and circulation.

The north slough that separates the main portion of Tenasillahe Island from the island abutting Multnomah Channel and the Columbia River upstream of Multnomah Channel could be improved by placement of a controlled inlet structure at the Columbia River and improvements to the tidegates at Multnomah Channel (Station 228+01). The headwaters of the main western slough channel, in the interior of Tenasillahe Island, are adjacent to Clifton Channel. Historically, there was a pump house and tidebox at this location (Station 4+44). The tidebox is no longer functional. A controlled inlet could be constructed at this location for importation of Columbia River flows and thus juvenile salmonids. Similar to the north slough, improvements to the tidegates would be required at Station 270+93 to ensure flows are exhausted and juvenile salmonids can readily exit the system.

The following actions will be taken as part of the Tenasillahe Island interim restoration effort:

- Conduct hydraulic engineering analyses of inlet and tidegate structures to ensure water control structures are of sufficient design and capacity to safeguard Columbia white-tailed deer habitat interior to the main flood control levees
- Fund and implement construction efforts for the interim
- Monitor post-construction benthic productivity and fish species composition and density on the restoration site and an adjacent control site
- Prepare annual reports of post-construction results to the Adaptive Management Team

8.2.4.2 Step 2 – Long-Term Restoration Features

The long-term ecosystem restoration features include restoring Tenasillahe Island to its historical habitat mixture. This long-term feature would be contingent on securing two (for a total of three) secure and viable Columbia white-tailed deer habitat sites. Options include securing lands in the subpopulation areas previously identified and possible acquisition of lands and habitat development at Lord-Walker, Fisher-Hump, and/or Cottonwood-Howard Islands. Cottonwood-Howard is discussed specifically below. These deer habitat acquisition actions are proceeding at various paces. The time frame for when two additional secure and viable subpopulations will be attained is unknown.

The attainment of three secure and viable subpopulations of Columbia white-tailed deer, not to include Tenasillahe Island, would provide an excellent opportunity to restore 1,778 acres of ESA Critical Habitat for salmonids in the Columbia River estuary. The restoration action would require removal of the downstream plugs on the interior drainage channels and reconnection via open channels of historical upstream connections. Construction actions could be easily implemented in a short timeframe at a minimal cost.

The following actions will be taken as part of the Tenasillahe Island long-term restoration effort:

- When Columbia White Tailed Deer are delisted, develop a plan to remove downstream plugs on the interior drainage channels and reconnect via open channels
- Monitor post-construction benthic productivity and fish species composition and density on the restoration site and an adjacent control site
- Submit annual reports of post-construction results to the Adaptive Management Team

8.2.5 Cottonwood/Howard Islands Columbia White-Tailed Deer Introduction

This feature is intended to provide secure habitat for Columbia white-tailed deer and represents an essential step toward the long-term restoration of historical habitats at Tenasillahe Island. The restoration feature, located at RM 68 to 71.5, is contingent on acquisition of Cottonwood and Howard Islands in their entirety by the Sponsor Ports, primarily for dredged material disposal actions associated with the Project. There is substantial acreage at Cottonwood/Howard Islands outside the disposal site boundaries for development or preservation as Columbia white-tailed deer habitat. Riparian forest currently exists in a relatively large block on the Carroll's Channel side of the island. Buffer zones (300 feet wide, per agreement with NMFS) have been established around the selected disposal sites to allow for natural development of riparian forest. Given the large size of these islands, which are presently joined as one island, and the presence of large blocks of riparian forest, the introduction of Columbia white-tailed deer by the USFWS is seen as viable at this location. Post-introduction monitoring will be required to determine the success of the introduction and whether a secure, viable population of Columbia white-tailed deer has been established.

Those areas designated for dredged material disposal and access/egress of dredging-related equipment in the EIS for the Project will be retained for that category of use for the life of the Project. Only lands exterior to the designated disposal site will be considered for restoration purposes.

The following actions will be taken as part of the Cottonwood/Howard Island ecosystem restoration feature:

- Land acquisition
- All actions necessary to accomplish translocation of Columbia white-tailed deer to Cottonwood/Howard Island, including NEPA/ESA coordination
- Funding of translocation efforts
- Habitat O&M
- Monitoring efforts to assess Columbia white-tailed deer translocation, including preparing an annual report for the Adaptive Management Team on the status of the translocation effort

8.2.6 Bachelor Slough Restoration

The Bachelor Slough Restoration action is located within the boundaries of the Ridgefield National Wildlife Refuge near Ridgefield, Washington. Bachelor Slough is a 2.75-mile-long side channel of the Columbia River branching off the mainstem at RM 91.5. The slough empties into Lake River, which opens into the Columbia River at RM 87.5. Bachelor Slough delineates the east boundary of Bachelor Island. The proposed instream restoration action would encompass 100 acres along the length of the slough. Approximately 132,000 cubic yards of material would be dredged from the bottom of the slough.

Bachelor Slough submerged lands and the upland disposal site adjacent to the Columbia River are both the property of WDNR and USFWS. Discussions are under way to secure easements from WDNR for use of their property for disposal.

The slough provides salmonid rearing habitat and, possibly, minor adult migration habitat. The slough currently is heavily silted, which impedes seasonal water flow, elevates water temperatures, reduces vegetation growth, and inhibits fish passage. The silted condition subjects native fishes and aquatic

wildlife to seasonal high levels of disturbance, extreme temperatures, unsuitable food and cover resources, and entrapment conditions. Removing some of the siltation while retaining some of the natural barriers to boat traffic will enhance fish habitat. This restoration feature includes removing invasive tree species and reed canarygrass and replacing them with native willows, ash, and cottonwoods on 6 acres.

This restoration feature proposes the removal of silt from approximately 300 feet north of the slough mouth (south tip of Bachelor Island) to the north end of the slough where it merges with Lake River. The first 300 feet of the slough mouth will not be dredged completely so as to discourage public recreational boating. Recreational boating, including jet skis, is a recognized source of wildlife disturbance and erosion within the slough. Current conditions (i.e., shallow water and minimal access at the mouth) limit boating activities to relatively small watercraft and seasonal use.

All dredging activity would occur in-water from November 1 to February 28 to minimize potential impacts to fish. The slough will be dredged to a depth of approximately 0.0 mean sea level at the bottom, with slopes of 7:1 to the adjacent embankments. The Ridgefield National Wildlife Refuge has three pump stations along Bachelor Slough. Deeper excavations will occur around the three refuge intake pumps to improve pump efficiency. Each pump intake is screened to prevent entrainment of juvenile salmonids; therefore, the proposed feature will have no adverse effect on salmonids. An estimated 132,000 cubic yards of dredged material will be removed.

Restoration of the embankment vegetation will occur on approximately 6 acres of the Bachelor Island shoreline. This will include the removal of invasive plants such as reed canarygrass, false indigo bush, and Himalayan blackberry. These plants will be replaced with a more palatable grass mixture, willows, and cottonwoods.

A specific disposal location for material dredged from the slough is being evaluated. If the material has a suitable silt content, it could be placed on old dredged material disposal locations, either upland or along the Columbia River shoreline. There the material would provide a suitable substrate for development of riparian forest habitat. Natural establishment of riparian forest trees would be relied on for stand development because the presence of bare mineral soil in May through early June during seed dispersal by cottonwoods and willows will result in natural establishment of riparian forest stands. Dredged material will provide that type of substrate; minor tillage in spring prior to seed dispersal would be sufficient to control weeds or other competitive vegetation that may develop between disposal and spring.

The Bachelor Slough ecosystem restoration feature is contingent on the Corps' evaluation of sediment chemistry and approval by WDNR to dispose of dredged material on their property for further riparian habitat creation. Backwater channels are more likely to contain fine-grained sediments (silts) with a high organic content and, therefore, a greater likelihood of contaminants (e.g., PCBs, DDT, DDE) than coarser-grained sands with low organic content found in the main navigation channel. As a result, a sediment chemistry evaluation is necessary to determine contaminant levels. Construction is proposed using a pipeline dredge, working during November 1 through February 28, and disposing of dredged material on WDNR property to increase the riparian habitat.

The following actions will be taken as part of the Bachelor Slough ecosystem restoration feature:

- Conduct sediment chemistry evaluation
- Conduct dredging of Bachelor Slough
- Obtain real estate instruments in order to dredge Bachelor Slough and place materials at an upland location

- Provide initial tillage of upland dredged material disposal site, if necessary, to provide suitable substrate for riparian tree seedling establishment
- Restore 6 acres of riparian forest habitat
- Perform riparian forest O&M
- Perform O&M dredging, as required, to maintain restoration depths in Bachelor Slough
- Monitor fisheries use of Bachelor Slough for a 5-year period, including providing annual and final reports on findings to the Corps, NMFS, and Washington Department of Fish and Wildlife (WDFW)

8.3 Ecosystem Research Actions

Ecosystem research actions are measures taken by the Corps as part of the proposed Project to assist the efforts of the Corps, the Services, and others in the broader issues of understanding the lower Columbia River ecosystem. These research actions address indicators of the salmonid conceptual model where additional studies would provide useful information to the recovery of the species. These research actions will advance the knowledge base for the recovery of the species. The annual and cumulative results will be presented to the Adaptive Management Team (see Section 9).

Research actions proposed for the Project are shown in Table 8-1. This table identifies the ecosystem research actions that the Corps proposes to implement under this BA.

Table 8-1: ESA Sec. 7(a)(1) Ecosystem Research Actions (ERA)

ERA Number	Indicator	Monitoring Task	Justification	Duration	Data Analysis	Management Decision
ERA-1	Tidal Marsh and Swamp Habitat, Shallow Water and Flats Habitat, Water Column Habitat	Add one or two additional transects in different habitat types similar to those being done for the NMFS studies currently under way with AFEP	Provide additional habitat and salmonid distribution information for the estuary. Useful in establishing inventory information for future monitoring or restoration.	Begin before construction and for 3 years after completion of the project.	Record value and use of different habitat types for juvenile salmonids and cutthroat trout.	Determine if task should continue and what funding source is appropriate.
ERA-2	Tidal Marsh and Swamp Habitat, Shallow Water and Flats Habitat, Water Column Habitat	Add upriver transect (upstream of RM 35) to evaluate cutthroat and juvenile salmonid use of the riverine area.	Little is known about the species use of this habitat. To provide additional information regarding salmonids use of this habitat.	Begin during construction and end 3 years after completion of the project.	Record value and use of different habitat types by juvenile salmonids and cutthroat trout.	Determine if task should continue and what funding source is appropriate.
ERA-3	Bathymetry, Shallow Water and Flats Habitat	Conduct bank-to-bank hydrographic surveys of the estuary.	Has not been done in 20 years and is needed to assess available habitat and restoration actions.	Once, prior to construction.	Bathymetry will be available for shallow water areas in the estuary.	None required.
ERA-4	Contaminants	In conjunction with ongoing studies of juvenile salmonids habitat utilization in the lower Columbia River collect and analyze juvenile salmonids and their prey for concentrations of chemical contaminants.	Provide additional data on contaminants in listed salmonids and their prey. Useful in establishing inventory information for future monitoring or restoration.	Begin before construction during and up to 3 years after construction, depending on the results.	Record concentrations of persistent contaminants (e.g., DDTs, PCBs, PAHs, dioxin-like compounds) in juvenile salmonids and prey.	Determine if task should continue and what funding source is appropriate.
ERA-5	Contaminants	In conjunction with above contaminant study, assess sublethal effects of contaminants (e.g., growth, disease resistant) on salmonids.	Provide additional data for established contaminants thresholds effect levels to ensure that guidelines are protective of salmonids; to better characterize performance of juvenile salmonids in the estuary.	Begin before construction during and up to 3 years after construction, depending on the results.	Record health status of juvenile salmonids collected above.	Determine if task should continue and what funding source is appropriate.
ERA-6	Salinity, turbidity, and phytoplankton	ETM Workshop	To further the knowledge of the ETM and the listed stocks.	Once	Not required	None required.

Any study done should fit into the overall research effort that is being conducted or proposed by LCREP, NMFS, BPA and the Corps. In this way it will not be a duplication of effort will provide results that fit into what should be an overall goal for research in the estuary.

8.4 Analysis of Effects of Ecosystem Restoration Features and Research Actions

This section analyzes the potential to ESA-listed fish, wildlife, plants, and insects arising from implementation of six ecosystem restoration features and associated research actions set forth in Section 8.0. Additionally, this section addresses potential effects on salmonids associated with the three ecosystem restoration actions described in Section 3 of this BA and Chapter 4 of the FEIS (Corps, 1999a). Impacts to terrestrial species under USFWS's jurisdiction for these three actions and Miller/Pillar Island were previously addressed in the BA for the Project. Impacts to marine mammals and sea turtles were addressed in the DMMP BA. The conclusion of "no effect" from that document applies to the restoration features and research actions discussed here and is incorporated here by reference.

Ten species (Columbia white-tailed deer, bald eagle, marbled murrelet, western snowy plover, brown pelican, Oregon silverspot butterfly, Howellia, golden paintbrush, Bradshaw's lomatium, and Nelson's checkermallow) occur in the general area of these restoration actions. For detailed information on these species relative to their presence along the Columbia River, the reader should reference the BAs and BOs previously published for the Columbia River DMMP and Columbia River Channel Improvements. Two species, the peregrine falcon and the Aleutian Canada goose, have been delisted since the consultation on the FEIS was concluded and are not addressed in this BA. A brief description of the Corps' determinations is presented below.

Seven of the 10 species listed above (marbled murrelet, western snowy plover, Oregon silverspot butterfly, Howellia, golden paintbrush, Bradshaw's lomatium, and Nelson's checkermallow) do not occur in the areas identified for the nine ecosystem restoration features and research actions or were addressed in the previous BA (Corps, 1999b). Therefore, it is our determination that there will be "no effect" to these species from the six proposed ecosystem restoration actions set forth in this section. Determinations in the original BA for listed species (Corps, 1999b) for the three ecosystem restoration actions identified in the FEIS (Corps, 1999a) remain valid.

8.4.1 Ecosystem Restoration Features

8.4.1.1 Federally Listed Salmonid ESUs

Presence, abundance, distribution, and habitat association and use information pertaining to listed stocks are included in previous sections. The reader should refer to those sections for general information.

Benefits associated with individual restoration features are more clearly defined in the discussion for each action. Typically, the benefits associated with the proposed actions entail preservation of existing tidal marsh and swamp habitat, restoration of tidal marsh and swamp and shallow water and flats habitat and associated benthic invertebrate and fish populations, development of riparian forest, and improvements in access to side channel/backwater habitats.

Five of six restoration features identified in Section 8.2 (Lois Island Embayment Habitat Restoration, Purple Loosestrife Control, Miller/Pillar Habitat Restoration, Tenasillahe Island Interim and Long-term Restoration, and Bachelor Slough Restoration) occur in water and have the potential to affect listed salmonids. The translocation of Columbia white-tailed deer to Cottonwood/Howard Island will have no effect on listed salmonids as the action is upland in nature and does not affect habitat used by these species.

Two of three restoration actions identified in the FEIS (Corps, 1999a) (Restore Shallow Water Habitat, Tidegate Retrofits for Salmonid Passage and Improved Embayment Circulation) occur in-water, so they have the potential to affect listed salmonids. The Shillapoo Lake Restoration action, in the current configuration, would have no effect on listed salmonids because the action is interior to main flood control levees and upland in nature and, therefore, does not impact habitat used by these species.

Lois Island Embayment Habitat Restoration

Chinook salmon, primarily fall chinook subyearlings, were the most abundant (94 percent) juvenile salmonid captured in the embayment by Cates (1983). Chum and coho salmon and coastal cutthroat trout represented the remaining juvenile salmonids captured in the Lois Island Embayment by Cates (1983). The lowered presence of juvenile salmonids other than fall chinook subyearlings may be attributable to the present condition of the embayment, which is a large body of open water (389 acres), approximately 18 feet deep on average, with a rather uniform bottom substrate and lacking in structural diversity. Historically, the area included complex tidal marsh and swamp habitat with a deeper subtidal channel bisecting the area.

The objective of this restoration action is to mimic the historical substrate conditions in terms of elevation and rely on natural repopulation of the intertidal marsh, mudflat, and subtidal habitats by native flora and fauna. Adjacent tidal marshes and swamps, and shallow water and flats habitats are expected to provide the source populations for flora and fauna re-establishment.

The proposed restoration feature would be beneficial to listed salmonids because primary (plant) and benthic productivity should approach historical levels over time. The return of 389 acres of tidal marsh and swamp and shallow water and flats habitats represents a substantial restoration of estuarine productivity.

Construction actions for the restoration feature may result in temporary impacts to listed salmonids. The site will be restored using a pipeline dredge to transfer material placed by hopper dredges at the upstream end of the Tongue Point turning basin. Fish are expected to avoid the immediate area of the discharge during disposal operations. The materials to be placed are clean, median-grained sands from the Columbia River navigation channel; consequently, turbidity plumes associated with the discharge are expected to be minimal because most material would readily settle to the bottom. Much of the embayment restoration can occur during navigation channel construction when the bulk of the materials would be generated. However, a number of years of maintenance dredging would also be required to complete the restoration. Materials to be placed in the embayment are primarily clean, medium-grained sands that meet the criteria for in-water disposal. No contaminant concerns are foreseen (see Section 6.1.5, Accretion/Erosion). Timing windows and BMPs identified in Section 6 will apply to actions in this area. Materials stored temporarily in the Tongue Point turning basin are not expected to raise the river bottom to more than 30 feet below the surface; therefore, no effects to salmonid habitat are expected.

Recolonization of the restored embayment by plants and benthic invertebrates will take 5 to 10 years or more, depending on the species and their means of colonization. The tidal marsh fringing the embayment and the large expanses of tidal marsh in Cathlamet Bay represent a large source of plant propagules for the restoration site. Similarly, benthic organisms are abundant in Cathlamet Bay and represent an excellent source population for recolonization of the embayment. Benthic productivity and related use by salmonids may be less for an undetermined interim period as populations reestablish and densities increase. Plant productivity should increase steadily from current levels because the restoration actions would not affect the fringing tidal marsh habitat and swamp habitat currently present at the embayment.

It is our determination that the proposed action may adversely affect listed salmonids during restoration of historical elevations; however, over the long term, the proposed action should beneficially affect listed salmonids.

Purple Loosestrife Control

The restoration feature for purple loosestrife control would include an integrated pest management approach using biological agents, herbicides, and mechanical control measures. These actions would typically occur in the upper elevations of tidal marsh habitat and have little likelihood of adversely affecting salmonids directly or indirectly. Rodeo, an EPA-registered chemical approved for over-water application, would be used in conjunction with the other control measures. Rodeo application will result in the short-term loss of some native vegetation. It is anticipated that the herbicide will be wicked on to purple loosestrife, thereby lessening the potential for impacts to native vegetation, which is typically shorter in stature. Mechanical control (pulling) would only affect a small area at any given time, typically during lower tidal stages.

The purpose of this restoration feature is to eradicate purple loosestrife in the Columbia River estuary and retain the diverse, native flora composition of the tidal marsh habitat. Purple loosestrife domination of the tidal marsh flora would negatively impact benthic invertebrates that depend on detrital export from the tidal marsh habitat. Purple loosestrife domination would be detrimental to juvenile salmonids.

Our determination is that the use of herbicides as part of this restoration feature will have some short-term adverse effects but, in the long-term, the proposed restoration feature is likely to beneficially affect listed salmonids.

Miller/Pillar Habitat Restoration

The proposed restoration feature centers on restoration to its historical depth of an erosive area of the Columbia River at approximately RM 26. A NMFS study has indicated that the historical depth is a more productive elevation for benthic invertebrates, and therefore for juvenile salmonids as well. Site restoration would hinge on placement of dredged material to attain historical elevations and the construction of a pile dike field to hold the material in place once it is deposited on location.

Construction of this restoration action may result in the temporary displacement of juvenile salmonids from the immediate area of the discharge pipe or the pile dike construction location. Once construction is completed, future potential disturbance actions would be limited to O&M of the pile dikes, an intermittent effort over many years. Pilings and spreaders would be fitted with bird excluders to minimize or eliminate use by double-crested cormorants. This feature would also require intermittent O&M activities, but is water surface-oriented and poses minimal potential for impact to listed ESUs.

A previous study has established that driving of wood piles with an impact hammer does not produce sounds that are in the hearing range of salmonids. The action is not considered to affect salmonids.

It is our determination that the construction and O&M elements of this restoration action, for the short term, are likely to adversely affect listed salmonids, but are not likely to adversely affect them in the long term.

Tenasillahe Island

Two actions are anticipated as part of this ecosystem restoration feature. The interim action would be directed at improving connectivity and water exchange between sloughs/backwater channels interior to

the levees and the Columbia River. This would be accomplished through improvements to tidegates and provision of controlled inlets to improve water movement and accessibility for juvenile salmonids. These backwater channels represent rearing habitat for juvenile salmonids that is assumed to receive minimal use at present.

Over the long term, the levees would be breached to restore full tidal circulation to approximately 1,778 acres of former tidal marsh and swamp and forested swamp habitats. This long-term action is contingent on the delisting of Columbia white-tailed deer and determination that such actions are compatible with the purposes and goals of the refuge, to include restoration of tidal marsh and swamp and forested swamp habitats for ESA Critical Habitat (salmonids).

As a result of this ecosystem restoration feature, from the interim action to improve connectivity of interior channels to full restoration of tidal circulation to 1,778 acres of estuarine habitat, a substantial gain in salmonid habitat is envisioned. Increased export of detritus to the estuary from re-established marshes or forested swamp is also foreseen. Both the interim action and full-scale restoration would result in juvenile salmonids gaining additional acres of productive habitat for rearing and foraging.

Construction impacts related to either the interim or full-scale restoration feature are anticipated to be of short duration (a few days to a couple of weeks). The primary impact is likely to be an increase in turbidity localized around the construction actions. Through appropriate timing, impacts to juvenile salmonids in the immediate construction area can be further minimized.

It is the Corps' determination that the proposed action may have some short-term adverse effects, but is expected to result in long-term beneficial effects for listed salmonids.

Tidegate Retrofits for Salmonid Passage

This proposed ecosystem restoration feature is described in Section 3 and in more detail in Chapter 4 of the FEIS (Corps, 1999a). The feature consists of improvements to existing tidegates to improve anadromous fish movement through the structures. The Corps solicited lists of potential restoration actions from the Oregon and Washington Departments of Fish and Wildlife. Three Oregon tributaries to the Columbia River – Tide Creek, Grizzly Slough, and Fertile Valley Creek – were identified for ecosystem restoration actions. Two Washington streams – Burris Creek and Deep River—were also identified for retrofitting of tidegates. Additional tributaries would be considered if identified.

The new tidegates will be either a hinged door that fits over the end of a large-diameter drainage pipe that opens and closes in response to changes in hydraulic pressure or small sliding doors. New drainage pipes may be required at some locations depending on the age and condition of the current drainage pipe. The purpose of the retrofit is to increase the amount of time that fish have access through these structures. Construction would typically take place in late summer to take advantage of lower water levels, dry soil conditions, and the general absence of fish. It is the Corps' determination that the potential for impacts to listed ESUs is minimized. Construction actions are also of short duration (e.g., less than one week per structure) and soil disturbance, thus turbidity, would be typically minimal.

It is the Corps' determination that the construction element of this restoration action, for the short term, may affect but is not likely to adversely affect, listed salmonid ESUs, including coastal cutthroat trout. Longterm, the proposed restoration may affect (beneficial) the suite of listed fish species.

The tidegate retrofit restoration feature is estimated to provide or improve anadromous fisheries access to 38 miles of tributary streams. These tributaries contain spawning, stream rearing, and (near their

confluence with either the Columbia River or a more major tributary) backwater channel and freshwater marsh habitat for rearing and/or overwinter refuge from floods.

Access through tidegates would be improved through installation of sliding doors and/or tidegates. The sliding doors (fish slides) can be left open during outmigration and immigration periods to allow anadromous fish the opportunity to access or egress the stream on their timeframe, rather than strictly when tidal conditions (outgoing) provide for the tidegates to open.

Walker/Lord and Hump/Fisher Island Improved Embayment Circulation

This proposed ecosystem restoration feature is described in more detail in Chapter 4 of the FEIS (Corps, 1999a). The connecting channels between the Columbia River and the embayment formed by the connection of islands through dredged material disposal will be excavated. These embayments are generally open at only one end. As a result, water circulation is impeded and sediment settling tends to create a shallow, warm water environment. The purpose of this restoration action is to improve water flow and circulation, thereby lowering embayment temperatures and creating a network of channels. This feature should increase salmonid presence and foraging conditions for juvenile salmonids.

Construction activities are primarily upland in nature and involve construction of a channel in a historical dredged material deposition area. A brief period of in-water construction would occur when the channels at the embayment and river are opened. Given the short duration of the construction action and the fact that material to be excavated is primarily medium-grained sand, turbidity in adjacent waters should be of short duration and extent.

Construction timing would typically be late summer to take advantage of lower water levels, dry soil conditions, and the general absence of fish. As a result, the potential for impacts to salmonids is minimized.

It is our determination that the construction element of this restoration action may have short-term effects, but is not likely to adversely affect listed salmonids. Longterm, the proposed restoration should beneficially affect listed salmonids.

Martin Island Embayment

The proposed mitigation action entails placement of dredged material, with a cap of topsoil, to develop approximately 32 acres of tidal marsh habitat. A more detailed description of the proposed mitigation action can be referenced in Appendix G of the FEIS (Corps, 1999a). The existing embayment was dredged to provide fill for Interstate 5. The mitigation objective is to create intertidal marsh habitat for fish and wildlife, which would increase detrital export to the Columbia River.

Although the proposed mitigation action would have some effect on an aquatic environment that receives transitory use by juvenile salmonids, the intertidal habitat would be expected to increase the export of detrital material from the marsh habitat and provide for increased energy input to the Columbia River and the estuary. This would benefit benthic invertebrates, including those species that are used as forage resources by juvenile salmonids. In addition, development of tidal marsh habitat would not preclude use of the embayment by juvenile salmonids except during low tide periods.

Construction placement of dredged material and topsoil will increase turbidity. However, the principal material to be placed is medium-grained sand from the navigation channel. Sand would be expected to settle quickly, resulting in little escape of turbidity to the adjacent side channel. Placing topsoil would

create more turbidity than placing sand. The embayment is a quiet water environment with a narrow access channel. Consequently, export of turbidity to the side channel would be further lessened.

The proposed action may affect, but is not likely to adversely affect, listed stocks of salmonids.

Bachelor Slough

Restoration actions at this location are geared toward deepening the existing side channel habitat to remove accumulated sediments. From a fisheries perspective, this would increase flows traveling through the slough and should decrease water temperatures. Juvenile salmonids would be more likely to be drawn into Bachelor Slough under these changed conditions during the outmigration. Cooler temperatures would be beneficial to fish drawn into Bachelor Slough.

Disposal of material dredged from Bachelor Slough provides an opportunity to develop riparian forest on an old, sand-covered disposal site immediately adjacent to the Columbia River and within the zone of ESA Critical Habitat. Riparian forest restoration would provide for detrital (leaf) and insect faunal export to the Columbia River. Long term, riparian forest habitat would provide for export of large woody debris to the Columbia River and its estuary.

Sediment quality would be evaluated prior to implementation of the restoration feature to ensure contaminants are not an issue. The feature would be discontinued if contaminants were determined to be outside established regulatory parameters for upland disposal. Timing restrictions for pipeline dredging will minimize impacts to salmonids from dredging or disposal operations, particularly during in-water disposal.

The construction element of this restoration action may affect, but is not likely to adversely affect, listed salmonids. Long term, the proposed restoration may beneficially affect listed salmonids.

Shillapoo Lake Ecosystem Restoration

A detailed description of this ecosystem restoration feature is presented in Section 3 of this BA and Chapter 4 of the FEIS (Corps, 1999a). The principal construction effort for this feature will occur interior to the main flood control dikes. Additional work will occur around the tidegate and pump station that exhausts interior waters to Lake River. A porous rock levee would be constructed in the discharge channel to prevent fisheries entry into the Shillapoo Lake system where entrapment could otherwise occur. Construction of the rock levee would probably occur in late summer-early fall to take advantage of seasonally low water levels and the minimal presence of juvenile salmonids. A pump station to supply auxiliary water to the restoration area will either be added and/or an existing WDFW pump station will be upgraded. Thus, little of the proposed construction work will occur outside the flood protection levees. Pump installation and construction of the rock levee would result in negligible turbidity increase in the immediate area of the activity. Screens will be placed to prevent entrainment of juvenile salmonids by pumps.

It is the Corps' determination that the proposed action may affect, but is not likely to adversely affect, listed stocks of salmonids.

8.4.1.2 Columbia White-Tailed Deer

Restoration features for Lois Island Embayment, Purple Loosestrife Control, and Bachelor Slough will have no effect on Columbia white-tailed deer because this species is not present at these in-water habitat restoration locations.

Cottonwood/Howard Island Columbia White-Tailed Deer Introduction

No Columbia white-tailed deer are currently located on Cottonwood-Howard Island. USFWS proposes to transplant Columbia white-tailed deer to the island contingent on acquisition of the island by the Corps and the Sponsor Ports. USFWS will determine effects on Columbia white-tailed deer in future NEPA/ESA documentation of their Columbia white-tailed deer translocation efforts. There is some potential for take as a result of this translocation. Because the USFWS will be responsible for translocation, they will serve as the action agency for this effort and will reinitiate consultation at the time of the translocation effort when the agency has developed specific relocation plans.

Tenasillahe Island Interim and Long-Term Restoration

The restoration features proposed at Tenasillahe Island may result in temporary disturbance to Columbia white-tailed deer in the immediate area of the inlet and outlet structures that are being modified during the construction period. These disturbance bouts may entail a few days each at each structure and are severely constrained spatially. Design of inlet and outlet (water control) structures will be based on hydraulic engineering analyses, to ensure that water imported into the sloughs interior to the flood protection levees can be exhausted quickly and efficiently without flooding adjacent Columbia white-tailed deer habitat. The inlet structures will be designed with closure gates to ensure that inflows can be shut off during flood or high precipitation events to prevent interior flooding of Columbia white-tailed deer habitat. Therefore, it is our determination that the proposed restoration feature at Tenasillahe Island may affect, but is not likely to adversely affect, Columbia white-tailed deer.

The long-term restoration feature will involve the relocation of a substantial portion of the Tenasillahe Island Columbia white-tailed deer population. It should be noted that no relocation will occur unless the Columbia white-tailed deer is delisted; therefore, no adverse effect is expected for this species.

8.4.1.3 Bald Eagle

The Columbia River Recovery Zone (RZ 10), Pacific Bald Eagle Recovery Plan, which includes the proposed ecosystem restoration actions, has substantially exceeded the target number of bald eagle territories for both Habitat Management Goals (HMGs) and Recovery Population Goals (RPGs). For RZ 10, the HMG is 47 breeding territories and the RPG is 31 breeding territories. Eighty-nine breeding territories were surveyed in 2001 and 86 of these surveyed territories were occupied. Nesting outcome was determined for 85 nesting territories, of which 52 (61 percent) were successful in producing young. The 79 young represented a production rate of 0.93 young per occupied territory, slightly higher than the 5-year average of 0.85 young per occupied territory. For 2001, 1.52 young were produced per successful territory.

The Pacific State Bald Eagle Recovery Plan also identifies other criteria that must be attained in order for delisting to occur in addition to the HMGs and RPGs. These include an annual production rate of 1.0 young per occupied territory and an average success rate of not less than 65 percent over a 5-year period. Bald eagles in RZ 10 exceed two of the three criteria and are near the goal for young per occupied territory set forth in the Recovery Plan. Thus, there is room to accept some impact to this population

arising from implementation of ecosystem restoration measures, particularly given that the long-term benefits associated with the identified measures should be beneficial to bald eagles. The potential for impacts will be minimized as the Corps funds the Oregon Cooperative Fish and Wildlife Research Unit to fly bald eagle territory occupancy and productivity flights annually and uses the results to assess proposed actions and minimize or avoid disturbing bald eagles.

Lois Island Embayment

The proposed restoration of intertidal marsh/mudflat habitat and shallow subtidal channels in the Lois Island Embayment has the potential to initially adversely affect two resident pairs of bald eagles (e.g., the John Day Point/Lois Island and Tongue Point/Mill Creek pairs). These pairs nest adjacent to the proposed restoration area. The John Day Point/Lois Island pair's nest is approximately 1,500 feet from the nearest edge of the restoration area. The Tongue Point/Mill Creek pair's nests (includes alternatives) are much farther distant. Disturbance to the John Day Point/Lois Island nesting birds (at the nest location) can be avoided by directing construction actions to distant locations from their nest locations. The Tongue Point/Mill Creek pair's nest locations are sufficiently distant from the work area to preclude disturbance to their nesting activities.

There is potential for impacts to foraging activities of these pairs from restoration of the Lois Island Embayment. Such disturbance is more likely for the John Day Point/Lois Island pair than the Tongue Point/Mill Creek pair. The latter pair would be expected to focus their foraging activities near the Tongue Point docks, Tongue Point proper, and northward to Taylor Sands. These areas are sufficiently distant from the construction area as to preclude most incidences of disturbance. Further, this pair is habituated to substantial human activity associated with Tongue Point docks, Job Corps Station, and the Coast Guard Station plus sport fishing off Tongue Point. The John Day Point/Lois Island pair established their territory on the line that previously delineated the boundary between the Twilight and Tongue Point/Mill Creek pairs. Their obvious foraging area would be along the shorelines of Lois Island, including that abutting the embayment. As the restoration action encompasses an area of 389 acres and specific actions are restricted to a small portion of the total area at any given time, this pair will have ample opportunity to forage within their territory.

The consequence of implementation of ecosystem restoration actions at Lois Island Embayment may be temporary impacts to foraging activities of the John Day Point/Lois Island pair. Ultimately, the development of intertidal mudflat/marsh habitat interspersed with shallow subtidal channels will increase prey numbers and diversity for both pairs.

Thus, our final determination for this proposed restoration action is likely to have adverse effects initially, but has a long-term beneficial effect.

Purple Loosestrife Control

Purple loosestrife control measures will occur at intertidal marsh habitats scattered throughout the Columbia River estuary. Similarly, a resident, nesting bald eagle population is also scattered throughout the Columbia River estuary. Purple loosestrife control measures are expected to occur from June to September, inclusive. Thus, there will be overlap with the bald eagle habitat during the nesting period and human-eagle encounters can be expected to occur periodically during the execution of control measures. The potential exists for occasional disturbance to foraging bald eagles from implementation of survey and control actions. Such disturbances are expected to be short term in nature and only entail a small portion of the territorial area of any given bald eagle pair. Thus, alternative foraging areas would remain available to resident bald eagles within their territories. A 1,500-foot area around an active nest

would be avoided until young are successfully fledged and/or the nest is determined to be inactive for the breeding season.

The control of purple loosestrife in the intertidal marshes of the Columbia River estuary is an integral element of maintaining the productivity of these marshes for juvenile salmonids, waterfowl, bald eagles and other species. Loss of this productivity due to dominance by an exotic plant will ultimately harm all fish and wildlife populations that utilize these intertidal marshes. Consequently, short-term, controlled impacts to bald eagles are considered acceptable in order to implement restoration actions beneficial to the long-term health of the estuaries intertidal marsh habitat. Thus, our final determination for this proposed restoration action is likely to have adverse affects initially, but has a long-term beneficial effect.

Cottonwood/Howard Island

The presence and use of Cottonwood/Howard Island by bald eagles is discussed in detail in the Columbia River Channel Improvement Project Biological Assessment and subsequent Biological Opinion. The reader or reviewer should reference these documents for full background information.

The proposed action to introduce Columbia white-tailed deer to Cottonwood/Howard Island and to monitor the introduced population for an undetermined period has the potential for insignificant disturbance to bald eagles. Potential disturbance actions are associated with transplant efforts and the presence of humans monitoring the population and health of the Columbia white-tailed deer population. Any disturbance related to transplant and/or monitoring activities would be spatially confined and of short duration. Cottonwood/Howard Island represents a foraging location for bald eagles. Their foraging activities are typically confined to the periphery of the islands along the beaches and riparian forest-water interface. Whereas, activities associated with Columbia white-tailed deer would be primarily in the interior of the island complex.

It is our determination that the proposed action at Cottonwood/Howard Island may affect, but is not likely to adversely affect, bald eagles.

Bachelor Slough

The Bachelor Slough proposal entails deepening an existing, silted in, side channel of the Columbia River and disposal of excavated material, either in-water or potentially on adjacent WDNR land. The WDNR lands (upland site) lie immediately downstream of the inlet for Bachelor Slough, outside the refuge boundary, in an area of historical dredged material disposal. Dredging and disposal of Bachelor Slough sediments is contingent upon sediment chemistry results that indicate contaminants are not an environmental issue. Disposal actions are also contingent upon securing an easement for upland disposal activities. The following discussion addresses both in-water and upland disposal on the adjacent WDNR lands.

Bachelor Slough bisects the Ridgefield National Wildlife Refuge near Ridgefield, Washington. Dredging activities would occur between two bald eagle territories: e.g., the Bachelor Island and Mallard Slough pairs, which occur near the inlet for Bachelor Slough (Isaacs and Anthony, 2001). The Bachelor Slough pair is sufficiently distant from the dredging locations in the slough to preclude disturbance to the pair at the nest from that activity. However, upland disposal (via pipeline dredge) on the adjacent WDNR lands would occur near the current nest site for the Bachelor Slough pair. The Mallard Slough pair's nest, although closer to the inlet for Bachelor Slough, appears to be sufficiently distant and screened by trees to preclude disturbance from dredging activities at the nest site.

Given the assumption that disposal actions would occur on the WDNR uplands downstream of the inlet for Bachelor Slough, then timing restrictions would have to be employed to ensure that the nesting pair is not disturbed. The likely time frame for dredging Bachelor Slough to accomplish this objective would then be August to October, inclusive. Given this timing premise, disturbance to the pair's nesting activities could be precluded.

Upland disposal on WDNR lands, particularly if sediments from Bachelor Slough have a relatively high silt content, are expected to result in the appropriate conditions for development of riparian forest habitat. Black cottonwoods would be expected to be the dominant tree component of any stand that develops. Black cottonwoods, over time, would provide a suitable nest tree for bald eagles. Thus, the potential exists to expand riparian forest, and therefore nesting habitat for bald eagles, with upland disposal of Bachelor Slough sediments.

Dredging and disposal actions are expected to result in localized disturbance to foraging bald eagles from these resident pairs. Such disturbance would be confined to an area immediately around the dredge and disposal site plus for a very short time frame when the discharge pipe is laid out between the dredge and disposal site. Given the limited area affected by dredging and disposal activities, plus the large area generally associated with a bald eagle territory, the disturbance imposed is not considered a significant impact. Alternate foraging areas are available throughout these bird's territories; thus, they will not be precluded from successfully foraging within their territories. In-water disposal (e.g., flowlane in or adjacent to the Columbia River navigation channel) would be sufficiently offshore as to preclude disturbance to foraging bald eagles.

Contaminants associated with the sediments in Bachelor Slough are undetermined at this time. However, prior to implementation of the action, sediment chemistry analyses will be conducted to determine the presence and level of contaminants. Implementation of the action is contingent upon sediment chemistry results that demonstrate that sediments are suitable for in-water and/or upland disposal. Otherwise, no action will be implemented.

It is our determination that the proposed action at Bachelor Slough may affect, but is not likely to adversely affect, bald eagles.

8.4.1.4 Marine Mammals, Excluding Northern Sea Lions

The FEIS incorporated by reference the ESA determinations for marine mammals and sea turtles, from the DMMP BA in their entirety as the two actions were considered identical relative to the listed species (Corps, 1999a, Section 6.7.2). However, ecosystem restoration features and research actions differ and, consequently, are assessed separately in this document. For more detailed background information on these listed marine mammals and sea turtles, see the DMMP BA.

The proposed ecosystem restoration features and research actions would have no effect on hump-backed, right, finback, sei, blue, or sperm whales, or on Pacific leatherback, loggerhead, green, or Pacific Ridley sea turtles. These species do not occur in the action areas for these restoration features or research actions.

8.4.1.5 Northern Sea Lions

Northern sea lions are not expected to occur in the vicinity of the Tidegate Retrofits, Cottonwood-Howard Island, and Shillapoo Lake ecosystem restoration features. Actions ERA-4, ERA-5 (Contaminants), and ERA-6 (ETM workshop) would occur off-river. Thus, these restoration features and research actions

would have no effect on northern sea lions. Those restoration features and research actions, which have a potential to effect northern sea lions, are discussed below.

Lois Island Embayment Habitat Restoration

Northern sea lions may occur infrequently in the Lois Island Embayment when present in the Columbia River. They may occasionally forage in this embayment. Based on personal observation (Geoff Dorsey, Wildlife Biologist, Corps' Portland District), neither northern sea lions nor California sea lions have been observed in the embayment during the course of numerous visits across the seasons over a 20-year period (1981-2001). California sea lions have a heavily used haulout location a few miles downstream at the Astoria East Mooring Basin and are frequently observed in or adjacent to the main navigation channel at locations well upriver from this restoration feature area. The lack of observations in the embayment, coupled with frequent observations of California sea lions elsewhere in the river, would indicate that the embayment is not a preferred foraging area for either sea lion species. It is the Corps' determination that the proposed ecosystem feature may affect, but is not likely to adversely affect, northern sea lions.

Purple Loosestrife Control

Implementation of purple loosestrife control measures would occur in high elevation tidal marsh, likely during low tide. Northern sea lions inhabit deep, open water environments, not intertidal marsh habitat. Further, the only haulout for this species occurs on the south jetty of the Columbia River, well downstream of the proposed areas for feature implementation. Loosestrife control measures would use an herbicide that is EPA-registered for inwater application. Consequently, implementation of the purple loosestrife control feature would have no effect on northern sea lions.

Miller/Pillar Habitat Restoration

Northern sea lions may occur infrequently in or adjacent to the Miller/Pillar ecosystem restoration feature when they are present in the Columbia River. They may occasionally forage in or adjacent to the navigation channel, which abuts this restoration feature. Based on personal observation (Geoff Dorsey, Wildlife Biologist, Corps' Portland District), no northern sea lions have been observed in the Miller/Pillar restoration feature area during the course of numerous visits across the seasons over a 20-year period (1981-2001). California sea lions have been frequently observed in or adjacent to the main navigation channel at locations well upriver and downriver from this restoration feature area. Based on observations of California sea lions, we would expect the restoration feature area to provide a suitable foraging location for northern sea lions. All indications are that the number of northern sea lions present would be minimal.

The proposed feature entails the construction of a pile dike field and subsequent emplacement of dredged material to re-establish historical depths in the area to recapture the higher benthic invertebrate productivity and thereby increase the use and foraging quality of the area for juvenile salmonids. The two construction actions would be expected to result in temporary disturbances that would preclude northern sea lion use from their immediate vicinity. Given the extensive habitat area available to the species and the limited area impacted by the feature construction, northern sea lions can simply avoid the disturbance. It is our determination that the proposed action may affect, but is not likely to adversely affect, northern sea lions.

Tenasillahe Island Interim and Long-Term Restoration

Improving fish passage through implementation of tidegate improvements and increasing flows to these sloughs behind the main flood control levee has the potential for only a negligible amount of disturbance

to northern sea lions. Similarly, the breaching of these levees, the long-term restoration feature, only poses a minor potential for disturbance to northern sea lions. Northern sea lions primarily occur in or adjacent to the main navigation channel. This proposed feature is off-channel and in backwater areas where northern sea lions are not expected to occur. It is our determination that the proposed action may affect, but is not likely to adversely affect, northern sea lions.

Lord/Walker and Fisher/Hump Embayment Restoration

Implementation of the Lord/Walker and Fisher/Hump embayment restoration features would occur off-channel. Each restoration feature would primarily entail the excavation of a channel in an upland setting, except where each channel is daylighted to the Columbia River and the embayment. Each feature is expected to take only a day or two to construct. The presence of northern sea lions in the restoration feature areas is unlikely, given the nature of the habitat (off-channel and upland). It is the Corps' determination that the proposed action may affect, but is not likely to adversely affect, northern sea lions.

Bachelor Slough

Implementation of this restoration feature would occur off-channel in a shallow side channel of the Columbia River. Bachelor Slough, near RM 93, lies well upstream of the normal incursion of northern sea lions into the Columbia River.

The proposed feature would be constructed using a small pipeline dredge with disposal occurring in an upland location adjacent to the Columbia River. Should northern sea lions occur in the project area, they would be expected to avoid the immediate area of the dredge. As the species is very mobile, they would be expected to move easily to a new location to continue their activities. The Columbia River offers the species abundant habitat; consequently, exclusion from a small area would have a negligible effect on northern sea lions.

Dredging of Bachelor Slough sediments is contingent on sediments not being contaminated. Contaminant levels will be determined prior to dredging implementation via testing by approved protocols. If contaminant levels in the sediments are outside established limits, the action will not be implemented.

It is the Corps' determination that the proposed feature may affect, but is not likely to adversely affect northern sea lions.

8.4.2 Ecosystem Research Actions

Six ESA Section 7(A)(1) ecosystem research actions have been proposed (see Table 8-1). Three actions (e.g., ERA-1, ERA-2 and ERA-4) involve physical (sampling) activities within the estuary. Action ERA-4 simply represents collection of fish while implementing ERA-1 and ERA-2 inventory actions. Action ERA-5 uses juvenile salmonids collected for Action ERA-4 and would occur in a laboratory setting. Action ERA-6 is a workshop on the ETM. Action ERA-3 is a bathymetric survey of the Columbia River estuary. Actions ERA-3, ERA-5 and ERA-6 have been determined to have no effect on any listed species under the purview of the Services. Action ERA-5 relies on fish sacrificed for Action ERA-4. Thus the effect is associated with Action ERA-4.

Actions ERA-1, -2, -3, and -4 have the potential to affect only three species under the purview of the USFWS, bald eagles, brown pelicans and coastal cutthroat trout. None of the other species under the Services purview, Columbia white-tailed deer, marbled murrelet, western snowy plover, Oregon silverspot butterfly, Howellia, golden paintbrush, Bradshaw's lomatium, Nelson's checkermallow, and

bull trout are not expected to occur in the action area and therefore would not be affected by research implementation.

8.4.2.1 Federally Listed Salmonid ESUs, Excluding Coastal Cutthroat Trout and Bull Trout

Actions ERA-1, ERA-2, and ERA-4 would represent a take of listed stocks of juvenile salmonids. Constraints and requirements set forth by the NMFS for fisheries research actions involving listed stocks of juvenile salmonids will be adhered to by researchers. Research actions will be coordinated with and permitted by NMFS's Protected Resource Division, Portland, Oregon. Research proposals will be submitted that will indicate the listed stocks to be sampled, the number of fish anticipated to be handled and the number of fish required for sacrifice by ESU. Tabular information, published annually, lists predicted run sizes for various ESUs past specific geographical locations on the Columbia River. Using these projected run sizes and catch rate/efficiency of capture equipment, researchers will estimate the number of fish expected to be encountered during field research, percent of fish expected to be of wild stocks, and percent handling mortality. This and all other pertinent information relative to the permit requirements would be completed prior to field research implementation to the satisfaction of NMFS's Protected Resource Division.

Based on strict adherence to research protocols and permit requirements, it is our determination that the proposed action (Actions ERA-1, ERA-2, and ERA-4) may adversely affect and will result in a take of listed salmonids. However, the research action is intended to increase the knowledge base for these species to improve future management actions.

8.4.2.2 Coastal Cutthroat Trout and Bull Trout

Actions ERA-1, ERA-2, and ERA-4 would represent a take of juvenile coastal cutthroat trout. Bull trout will not be permitted to be collected, nor are they expected to occur in the area; thus, there will be no effect on the species. Research objectives will be set in accordance with biological information needs. Take of coastal cutthroat trout will be limited to a discrete sample size, determined in conjunction with USFWS representatives. Whether coastal cutthroat trout will be collected for sacrifice will also be determined in conjunction with Service biologists. The necessary permits for take will be acquired prior to field implementation of research and research protocol will be coordinated with and approved by the Service.

8.4.2.3 Bald Eagle

Actions ERA-1 through ERA-4 will occur in bald eagle habitat. All but ERA-3 entail activities along specified field transects in the Columbia River estuary, including transects upstream of RM 35. Action ERA-3 is a bathymetric survey of the entire Columbia River estuary.

Based on the historical data base detailing bald eagle nesting locations in the Columbia River estuary, plus future year bald eagle occupancy and productivity surveys that the Corps has committed to funding, transect locations can be regulated to preclude disturbance to nesting bald eagles. Occasional disturbance to foraging bald eagles may result from research activities along transects but such disturbance is expected to be temporally and spatially restricted. While foraging bald eagles may be temporarily excluded from a portion of their territory, these territories are sufficiently large that alternative foraging locations will be available to bald eagles.

The bathymetric survey effort will also result in incursions into bald eagle habitat. This activity would be anticipated to occur from a relatively small boat in the shallow water and flats habitat where bald eagles would be expected to occur. Further, surveys of tidal flats would be anticipated to occur primarily during high tides when bald eagle use of these areas is typically low. Constantly moving boats represent an insignificant disturbance potential to bald eagles as they soon move out of the area. Human presence is therefore limited and the perception of danger by bald eagles appears to be minimized. Knowledge of bald eagle nesting locations will be used to further ensure that researcher activity around nest sites is greatly minimized or eliminated.

Thus, it is the Corps' determination that Actions ERA-1 through ERA-4 may affect, but are not likely to adversely affect, bald eagles.

8.4.2.4 Brown Pelican

Actions ERA-1, ERA-3 and ERA-4 have the potential to affect brown pelicans. Disturbance potential associated with ERA-1 and ERA-4 is considered very minimal as few, if any, transects are likely to be placed in areas of the estuary (Columbia River mouth, East Sand Island, Baker Bay) where brown pelican concentrations develop. East Sand Island and pile dikes around East Sand/West Sand Island and the Chinook channel entrance support the largest concentrations of brown pelican, principally from mid-May to October with the largest presence during July-September. Actions ERA-1 and ERA-4, particularly if they do not include the shorelines of East Sand Island, have an insignificant disturbance effect on brown pelicans. Bathymetric surveys, if they approach within 100 yards of the shoreline of East Sand Island, would result in the flushing of large concentrations (more than 2,000 birds) of brown pelicans. To avoid such circumstances, bathymetric surveys would be implemented when brown pelicans are not present.

Thus it is the Corps' determination that the proposed action may affect, but is not likely to adversely affect, brown pelicans.

8.4.2.5 Northern Sea Lions

Action ERA-1 would add additional transects (one or two) to the research effort being conducted for NMFS under AFEP. Research actions along each transect are spatially limited to a small area and are short term in nature during each survey period. Given the extensive habitat area available to the species in either the estuary or river proper, and the limited area impacted by the research action, northern sea lions can simply avoid the disturbance. It is the Corps' determination that the proposed action may affect, but is not likely to adversely affect, northern sea lions.

Action ERA-2 would add one additional transect upstream of RM 35 to the research effort being conducted for NMFS under AFEP. Research actions along each transect are spatially limited to a small area and are short term in nature during each survey period. Given the extensive habitat area available to the species in the river proper, and the limited area impacted by the research action, northern sea lions can simply avoid the disturbance. It is the Corps' determination that the proposed action may affect, but is not likely to adversely affect, northern sea lions.

Action ERA-3 is a bank-to-bank hydrographic survey of the Columbia River estuary. Hydrographic surveys are typically conducted using survey boats traversing specific survey lines. Boats thus run along a steady heading at a steady speed. There is a small probability of encounters with northern sea lions during the course of these surveys. Sea lion reaction to an encounter with a boat is to dive and move a short distance from the boat's course before resuming normal activities. Such encounters are short-lived, typically less than 30 seconds. These disturbance actions do not constitute a threat to the survival of

northern sea lions. It is the Corps' determination that the proposed action may affect, but is not likely to adversely affect, northern sea lions.

Action ERA-4 entails the collection for further scientific study of juvenile salmonids collected during execution of research Actions ERA-1 and ERA-2. No additional disturbance to northern sea lions would result because of implementation of this action. It is our determination that the proposed action may affect, but is not likely to adversely affect, northern sea lions.

8.5 Conclusion

Under this BA, the Corps has modified the project to include these ecosystem restoration and research actions allowed at its discretion under Section 7(a)(1) of the ESA. These actions will restore and improve the habitat and increase knowledge of listed and candidate salmonid species as well as other native species found in the lower Columbia River ecosystem. The area, type, value, and function for each feature are listed in Table 8-2. The Corps will develop detailed proposals, which will be coordinated with the Services, and then work to implement them using the process described in Section 9.2, Adaptive Management Process.

Table 8-2: Ecosystem Restoration Features for the Project

Feature	Area Affected by Restoration (acres)	Type, Function, and Value
Lois Island Embayment Habitat Restoration	389	Type: Tidal marsh and swamp; shallow water and flats habitat Function: Provide rearing habitat for ocean-type salmonids; increase detrital export Value: High
Purple Loosestrife Control Program	300	Type: Tidal marsh and swamp Function: Maintain native Tidal marsh plant community; increase detrital export Value: High
Miller/Pillar Habitat Restoration	161	Type: Shallow water and flats habitat Function: Provide rearing habitat for ocean-type salmonids; increase benthic invertebrate productivity Value: High
Tenasillahe Island Interim Restoration ¹ (Tidegate/Inlet Improvements)	92	Type: Backwater/side channel reconnection to Columbia River Function: Increase access/egress for ocean-type salmonids Value: Moderate
Tidegate Retrofits for Salmonid Passage	38 miles	Type: Tributary reconnection to Columbia River Function: Increase access/egress for ocean-type salmonids; improve access for adult salmonids to headwaters for spawning Value: High
Walker/Lord and Hump/Fisher Islands Improved Embayment Circulation	335	Type: Marsh and swamp; shallow water and flats habitat Function: Provide rearing habitat for ocean-type salmonids; increase benthic invertebrate productivity Value: Moderate
Martin Island Embayment	32	Type: Tidal marsh and swamp (wildlife mitigation) Function: Increase detrital export; provide rearing habitat for ocean-type salmonids Value: Moderate (salmonids); high (wildlife)
Cottonwood/Howard Island Proposal ² Columbia White-Tailed Deer Introduction	1,000	Type: Translocation of Columbia white-tailed deer Function: Establish secure, viable subpopulation of Columbia white-tailed deer Value: High
Tenasillahe Island Long-Term Restorations ³ (Dike Breach)	1,778	Type: Tidal marsh and swamp; shallow water and flats habitat Function: Provide rearing habitat for ocean-type salmonids; increase detrital export Value: High
Bachelor Slough Restoration ⁴	300 (instream restoration) 6 (shoreline) 27 (riparian restoration)	Type: Shallow water and flats habitat; riparian forest Function: Provide rearing habitat for ocean-type salmonids; increase detrital export Value: Moderate (side channel); high (riparian forest)
Shillapoo Lake Restoration ⁵	1,250 acres	Type: Managed wetlands Function: Increase waterfowl, shorebird, wading bird, and raptor habitat Value: High
<p>Notes: The Tidegate Retrofits for Salmonid Passage, Walker/Lord and Hump/Fisher Islands Improved Embayment Circulation, and Shillapoo Lake Restoration features were proposed in the original FEIS (Corps, 1999a). The remaining restoration features were added during the BA reconsultation process.</p> <p>¹This restoration is contingent on hydraulic analysis results.</p> <p>²This restoration primarily benefits Columbia white-tailed deer.</p> <p>³This restoration feature is contingent on the delisting of Columbia white-tailed deer.</p> <p>⁴This restoration feature is contingent on sediment testing and approval by WDNR.</p> <p>⁵This restoration primarily benefits waterfowl, but would create detrital input to the Columbia River.</p>		